

Pressure Treatment of Rainbow Trout Eggs

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October 2016

A summary of the triploidy tests using pressure treatment of rainbow trout eggs is given in Table 1 below. The triploidy induction process requires the optimization of three different variables: pressure, the duration of the pressure, and the time of initiation of the pressure, which is influenced by temperature. By combining the effect of temperature into a combined unit ($^{\circ}\text{C-min}$), adjustments can be made for various temperatures typically encountered at salmonid hatcheries. E.g., at 10°C at 30 min after fertilization, the combined unit equals 300°C-min ; adjusting to 9°C , the induction time becomes $300/9 = 33.3$ minutes. This combined unit is provided in the table (where data makes it possible).

Although Chourrout (1984) claims to have achieved 100% triploidy using 7,000 psi, most of the other work shown in the table indicates that higher pressures are needed for consistent high levels of triploidy. For studies achieving 100% triploidy, pressures of 9,150 to 10,000 psi were needed. Pressures of 9,500 to 10,000 psi are recommended.

Much of the research has focused on timing of the shock, which is dependent on temperature, which affects the speed of ontogenetic development. The time for initiating a pressure treatment that results in 100% triploidy has varied from 300 to 400°C-min , with high results (99.1% triploid) at values as high as 475°C-min . This indicates that there is a range of potential induction times (e.g., between 30 and 40 min after fertilization at 10°C) that all result in 100% triploids. According to John Cassinelli (pers. commun.), Idaho Fish and Game is using 363°C-min (33 min at 11°C) for pressure treatment (9,500 for 5 min) of rainbow trout eggs. At temperatures encountered at Egan and Mantua State Fish Hatchery (9°C), the induction time would be 40 min. 20 sec. after fertilization.

The duration of pressure treatment has varied from 2 to 10 min among the studies in Table 1. Durations of 4 to 6 min have all been associated with 100% triploidy outcomes. In a production hatchery, this duration is of importance when multiple iterations of egg treatment are required to get all the eggs pressure treated during a spawning day. For a starting point for a recipe, 5 min is recommended, but testing of 4 min is worth exploring.

So, given the discussion above, I recommend using a pressure of 9,500 to 10,000 psi for 5 min at 363°C-min (40. min 20 sec. after fertilization) as a starting recipe.

Experiments should be conducted to determine how results might differ using slightly shorter times (e.g., 35-38 min) which might help with spawn-day logistics in the long-run. Comparison of the consistency of triploidy induction between 9,500 and 10,000 psi is also worth evaluating, as well as a comparison of egg survival.

Table1. Summary of triploidy percentages for rainbow trout eggs subjected to hydrostatic pressure in various experiments. The results are presented in chronological order and by pressure within a study. The highest triploidy rates are shown in bold type for each study.

Pressure (psi)	Duration (min)	Time Post-fertilization (min)	Temperature °C	°C-min	Triploid (%)	Reference
7,000	3-7	40	9.4	376	100	Chourrout 1984
8,000	10	35	No data		90	Lou and Purdom 1984
	10	40			90	
9,245-9,956	6-10	5-30	10		100 (2N gynogens)	Onozato 1984
9,000	3-8			400-500	92-99	Lincoln 1989
7,977	2	25	7.5	187.5	9.3	Guoxiong et al. 1989
	4	25	7.5	187.5	0	
	6	25	7.5	187.5	11.5	
9,000	2	25	7.5	187.5	3.9	
	4	25	7.5	187.5	3.7	
	6	25	7.5	187.5	20.1	
10,000	2	25	7.5	187.5	0	
	4	25	7.5	187.5	20.2	
	6	25	7.5	187.5	49.9	
11,000	2	25	7.5	187.5	3.3	
	4	25	7.5	187.5	18.8	
	6	25	7.5	187.5	27.0	
12,000	2	25	7.5	187.5	13.7	
	4	25	7.5	187.5	28.1	
	6	25	7.5	187.5	30.2	
8,500	5	25	10	250	5	Yesaki et al. 1996
8,500	5	40	10	400	68	
9,500	5	25	10	250	80	
9,500	5	40	10	400	100	
6,000	4	10	9.4-11.3		17	Hamor et al. 1996
6,000	4	20	9.4-11.3		43	
6,000	4	30	9.4-11.3		60	
8,000	4	10	9.4-11.3		37	
8,000	4	20	9.4-11.3		50	
8,000	4	30	9.4-11.3		77	
10,000	4	10	9.4-11.3		60	
10,000	4	20	9.4-11.3		80	
10,000	4	30	9.4-11.3		100	
9,150 9,700, 10,400	5	30	10	300	100	Wickwire 2000 Best survival at 9,700psi
9,000	5	40	7.5	300	10.0	Kozfkay 2003 ^a
9,000	5	53:20	7.5	400	11.8	

9,500	5	40	7.5	300	88.0	
Pressure (psi)	Duration (min)	Time Post-fertilization (min)	Temperature °C	°C-min	Triploid (%)	Reference
9,500	5	53:20	7.5	400	86.4	Kozfkay 2003 ^a
10,000	5	40	7.5	300	100.0	
10,000	5	53:20	7.5	400	91.6	
8,000	5		11.1	300	74.6	Couture et al. 2007
8,500	5		11.1	300	94.2	
9,000	5		11.1	300	98.3	
9,500	5		11.1	300	100.0	
10,000	5		11.1	300	100.0	
9,500	3		11.1	300	95.0	
9,500	4		11.1	300	99.2	
9,500	5		11.1	300	97.5	
9,500	6		11.1	300	100.0	
9,000	5	36	8.3	300	82.2	Loopstra and Hansen 2008
9,000	5	47	8.1	375	99.1	
9,000	5	59	8.1	475	93.6	
9,500	5	36	8.3	300	95.5	Loopstra and Hansen 2008
9,500	5	47	8.1	375	99.1	
9,500	5	59	8.1	475	99.1	
10,000	5	36	8.3	300	100.0	
10,000	5	47	8.1	375	98.2	
10,000	5	59	8.1	475	99.1	

^arainbow trout x Yellowstone cutthroat trout hybrid

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